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A DISCOVERY OF THE TRUE CAUSE Of the Wonderful Multiplication of Corn; with some General Remarks Upon the Nature of Trees and Plants.

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THE

PREFACE.

NOT all that delight in Truth, have the ſame Views: Some mind nothing but ſpeculative Sciences and the Productions of rare Wits, either to gain themſelves Applauſe, or becauſe they find a particular Pleaſure in them: Others on the contrary will not value an Invention any further than it influences and promotes the Happineſs of human Life. The Underſtanding of the latter is generally of a very narrow Compaſs; whence it proceeds that they deſpiſe every Thing as Trifles and Whimſies that they cannot penetrate into, and where an Advantage is not immediately and manifeſtly ſhewn. So on the other Hand thoſe Sciences, which are indeed of a certain Uſe in human Society, yet do not require Depth of Study, are look'd upon by great Scholars as mere Arts to get a Livelyhood by. As for my own Part, I am the more pleaſed with a Truth, the deeper the Notions of it are, but I eſteem it ſtill the more, the more advantageous it proves to the Commonwealth. Truths of the former Kind demonſtrate the Perfection of the human Intellect, not only in the Inventor, but in him alſo that's able to apprehend them: very often they ſhew likewiſe hidden Perfections in the Thing it ſelf. Why ſhould they not therefore cauſe Matter of great Pleaſure to a reaſonable Man, all Pleaſure conſiſting in the Senſe of Perfection? Truths of the latter Sort, and where the common Good is concern'd, are more needful than the former that give but a private Pleaſure. For, to examine the Thing narrowly, the Reaſon of our making much of a Truth, that gives Pleaſure, is, becauſe we conſider this Pleaſure as a Part of human Happineſs: Who therefore can take it amiſs, that a Man makes more Account of a Thing that is needful, than of another that is leſs ſo? I am uſed to compare thoſe Arts, which the Society of Mankind has extreamly need of, to Bread, and the others to Diamonds. He that is not poſſeſſed of more than what pays for his daily Bread, does well not to care for Jewels, but a wealthy Man may purchaſe rich Stones to charm his Eyes and Mind with. However, it behoves us to judge of the Uſe a Truth may be of, with a great deal of Diſcretion; for ſometimes it muſt be far fetched, but is of great Importance when found out. It muſt be ſaid in Praiſe of the Academies of Sciences, that they have ſucceſsfully endeavoured hitherto, to ſet in a clear Light Things of uncommon Penetration! But I wonder that there are not alſo Academies erected yet, whoſe Buſineſs it would be to enquire into Truths, which might advance the Welfare of Society. The learned Members or Fellows of thoſe Academies have explained hitherto nothing elſe but Parts of Mathematicks, Aſtronomy, natural Philoſophy and Phyſick, or generally Things of a ſublime Nature: But none or very few of them have undertaken to conſider either Virtue, or the Art of Government, or Matters of Husbandry, and many other Things relating thereto, the ſolid Examination whereof demands as much Penetration as Geometry does. I don't think that there is no Occaſion for a better Enquiry into theſe Things, and that it is ſufficiently known what may procure an Advantage to the Publick, or that it is at leaſt eaſily to be diſcovered when Occaſion does offer; For Experience ſhews the contrary. I have made it evident in the following Piece, that a great many Things might be improved in Husbandry. It is plainly proved not only by good Arguments, but by infallible Experiments too, that every Grain of Seed is endowed with an infinite Faculty, continually to produce Ears and Grains, and to yield ſome thouſand-fold Fruits according to the preſent Nature of Things. I have made it appear very probable, that a much more advantagious Manure might be made Uſe of than what has been uſed hitherto. Laſtly, it is obſerved, that till now nothing has been known of the true Nature of Blaſts in Corn, and that accordingly all Remedies in that Caſe muſt have proved fruitleſs. But ſuch Enquiries cannot be made without a Skill in natural Things, an Exerciſe in Experiments, Obſervations and Reflections, as every Body may ſee that will fix a little Attention upon the preſent Work. Nay, if any one would practiſe the Maxims I have given, in Agriculture, he muſt without Doubt apply himſelf to Mathematicks: Therefore Enquiries of this Nature belong to Academies of Sciences, whoſe Buſineſs it is to enquire into Truths unknown. I could enlarge upon a great many Things more about Husbandry and Gardening if I was not perſuaded that every Body will be ſenſible of them. I ſhall but inſtance one Thing more: Thoſe that are entruſted with the Care of the Eſtates of Princes cannot be blamed if they make but ſhift to improve the Rents of them, this being their Duty.

But if we conſider their Proceedings we find that they make Uſe of quite wrong Ways and Means. For their Cunning conſiſts in enriching the Prince with the Property of the Subject, under Pretence of Right; whereas it has been moſt evidently proved along while ago, that a Prince cannot be reckon'd rich, but when the Coffers of his Subjects are well filled. He therefore that will enrich his Prince, muſt find out a Way that the Subject may gain and ſave more. Now all the Acquiſitions of Treatiſes conſiſting in Husbandry, Trade, and Handy-work, the Advancement of thoſe Things muſt be the chief Care of a Miniſter. But many uſefull Problems are obvious in theſe Things, which are not to be ſolved but by him that is verſed in Mathematicks and natural Philoſophy, and that has made it his Buſineſs to reflect upon Things. Accordingly they ought to be Part of the Occupations of thoſe Societies of learned Men; or Princes ought to have at leaſt ſome among their Officers that are capable of ſolving Problems ſerviceable to the Publick. This is the chief End of my own Labours too, agreeable to which I endeavour to ſet uſeful Sciences upon ſuch a Footing, as may enable Mankind to go about ſo ſalutary a Work. To this End I do not reſt ſatisfied with the Explication of any natural Things that are not made evident by undoubted Experience, nor mind any poor Fictions by which ſome fancy to drive into to the Bottom of Nature: Witneſs theſe few Meditations. As for other Sciences, I try no leſs to give them all poſſible Certainty and Perſpicuity, and to adjuſt them to the Happineſs of human Society, and I don't doubt but that Succeſs will anſwer my Labour when I have Time to collect the Reflections which I have for ſome Time propoſed in my Lectures. As to the reſt, concerning this little Treatiſe, my Deſign is to illuſtrate Husbandry and Gardening, and to encourage others by theſe Means, to meditate upon natural Phenomena's. To this Purpoſe, I have amply talked of the Opportunity I have had to think on the preſent Subject, and of my Method in reaſoning and making of Experiments, till I came to know at laſt what I aim'd at. By this any Body may ſee how he muſt go to work to come at a due Knowledge of the Faculties of Nature. I have referr'd here and there to my *Reflections about the Faculties of the human Underſtanding and their right Application in the Knowledge of Truth*, for to ſhew, that the Rules I have ſettled therein, do as much Service in Matters of Reaſoning, as poſſibly may be expected from Rules. For Rules indicate only what is to be done, but don't qualify you to put Things into Practice, which is to be obtained only by frequently employing the Faculties of the Intellect. I flatter my ſelf not to have ſaid too much when I ſay that I have illuſtrated Husbandry and Gardening. For, ſupported by my Invention, one may account for a great many Things belonging thereto, which there was formerly no accounting for at all. But I am the firſt that has made an Eſſay to give Husbandry and Gardening a Form of Science. The Subject it ſelf has indeed been treated at large and ſucceſsfully by many Authors, but none of them having a thorough Inſight into Nature, have try'd to make good their Rules by the Means of a thorough Knowledge of Nature. But this will be facilitated if but what I have begun is carry'd on. I ſhall not fail to contribute towards it my ſelf, if God is pleaſed to grant me Life and Health, and Opportunity is given me; nor ſhall I for want of this, be unwilling to aſſiſt others, to whom it is offer'd with my good Advice.

A
DISCOVERY
OF THE
Multiplication of Corn.

CHAP. I.

Of the Occaſion of theſe Conſiderations.

§. I. IT were to be wiſhed that thoſe Gentlemen, who by their new Inventions improve the Arts and Sciences, would be pleaſed at the ſame time, truly to communicate to the Reader what firſt gave riſe to their Diſcoveries. For by this, many a Reader would be encouraged to meditate himſelf upon things, who is contented either to keep only in his Memory the Inventions of another, or at the beſt to enquire only into the Truth of 'em.

§. 2. It has always been my Endeavour to be of ſome uſe to my Fellow-Creatures, and I find my ſelf obliged to acquaint them, not only with the Method I have taken, to find out the true Reaſon of that prodigious Multiplication in Corn, but alſo with the occaſion I had. In treating of this preſent Subject, I ſhall begin with the Latter, namely, the Occaſion of theſe my Enquiries.

§. 3. A Book of the *French* Abbot *Vallemont* which he entitled, *Curioſitez de la Nature & de l'Art ſur la Vegetation, ou l'Agriculture & de Jardinage dans leur perfection.* 1708. Gave me the curioſity to read it, in order to know the Myſteries he promiſes in the Title Page, to reveal.

§. 4. The firſt of the Curioſities he propoſes is the Multiplication of Corn, treated of at length in the 6th and 7th Chapter. I ſoon fixed a particular Attention upon the 6th Chapter, finding no great Advantage in the foregoing Chapters, where the Author only expoſes at large the Pleaſures of a Country Life, with an Anatomy of Plants.

§. 5. Having finiſhed the reading of it, I ſaw that the Author's Treatiſe might be reduced to three Heads. I found that he told us in the firſt place, how that a great many Corn-ears had actually grown out of a ſingle Grain. I found in the ſecond place ſome ways and means, how to effect this always by Art; and in the third place, the Author's and others Opinion about the Cauſe of this Effect.

§. 6. I choſe to begin with the reading of the firſt Head for the following Reaſons. I love Truth above all Things; but I remembered to have met with more Truth in thoſe Books, that give us an

Account of natural Effects, than I have met with in thoſe, that pretend to determine the Cauſes of them. Nature is not to be ſtudied by ruminating at home, we muſt always begin our reflections with an exact Experiment, unleſs we have a mind to be impoſed upon by mere imagination. Notwithſtanding therefore the Author's not obſerving any order in his Account, I pickt up firſt of all the hiſtorical paſſages, that prove the Multiplication of Corn to be Matter of Fact.

§. 7. The firſt Inſtance he cites, is taken out of the *Ephemerides Naturæ Curioſorum*, 1671. which tells us of an extraordinary large Barley Ear, conſiſting of 15 large, and 9 little Ears, all filled with Corn, that came forth in *Sileſia*. Our Author obſerves, that ſome Natural Philoſophers believed, that this Ear was not grown out of a ſingle, but more little Grains accidentally fallen together; however he takes this Explication to be unneceſſary, knowing by Experience, that one ſingle Grain of Corn or Hemp, produces a Plant that ſpreads very far, in a garden of a fruitful Soil.

§. 8. The Author takes Notice afterwards *Page* 184. of Mr. *Denis*, Phyſician to the King of *France*, who by his reiterated Experiment, has drawn above 200 Ears out of one ſingle Grain.

§. 9. He aſſures *Page* 187. that the *Fathers of the Chriſtian Doctrine* at *Paris*, are poſſeſſed of a Cluſter of Barley that holds 249 Ears, and above 18000 Corns, all ſprouted forth out of a ſingle little Grain.

§. 10. He mentions *Page* 196. out of *Monconys* Travels, that a certain *Engliſh* Nobleman ordered his Corn to be clipt when it was green, and obtained thereby, that every ſingle Root produced near a Hundred Ears.

§. 11. Laſtly, the Author relates ſome Inſtances *C.* VII. *p.* 208. *& ſeq.* that Mr. *Dodart*, a Phyſician at *Paris* had recorded in the *Memoirs of the Royal Academy of Sciences*, 1700. This Gentleman has had in his Hands two Cluſters, one of which held above 100, and the other above 60 Ears. He has ſeen beſides that, at the Preſident *Tambonneau*'s two Cluſters of Wheat, one of them having 32 Halms, each of 'em with 10 Ears, and each Ear filled with 30 Grains, except the middlemoſt Ear, which held 36. According to this, one ſingle Cluſter conſiſted of 320 Ears with 9792 Grains. But when I conferred my ſelf to *The Memoirs of the Royal Academy of Sciences*, with what this Gentleman obſerves, I found in *Page m.* 203, 204, that M. *Dodart* has not been ſure of all thoſe Ears growing out of a ſingle Grain, but that he doubted, whether the Roots of more Grains laying one near the other, were not grown together.

§. 12. Upon the ſame account I remained yet uncertain, whether ever many Ears were produced by one ſingle Corn; not meeting with all the Circumſtances that are required for one to rely on another's Experience.

§. 13. And whereas we muſt not proceed to enquire into the Cauſes of a natural Effect, before we are aſſured of its Exiſtence; I thought it fit to make firſt an Experiment with ſome Grains, to the end that I might ſee if they would produce more than one Ear, when put into a good Garden Ground.

§. 14. The principal Way our Abbot ſhews for the Multiplication of Corn, is, to lay the Grains a ſoking in a Bog, or Water that has Salt-petre in it, before they are caſt upon the Field.

§. 15. I think it improper to mention here all the Author's Methods to lay the Corn a ſoking; it will be ſufficient to obſerve, that the Salt-petre is to be melted in ſeething Bogwater, to which may be added rain Water, wherein Horns or Claws of Beaſts, Leather, Feathers or Bones have lain putrifying, and that the Corn muſt ſwell up in it, and afterwards be aired a little, before it is ſown.

§. 16. Becauſe daily Experience ſhews, that Dung, Corn, and rain Water is of great Advantage to a Soil, and becauſe it has been thought of old, that Salt-petre likewiſe does it a great deal of good, which *Virgil. Georg. l.* 1. and *Columella de Re Ruſt.* confirms, who tells us, that formerly the Husbandmen were uſed to make their Seed fruitful by Salt-petre; I found no reaſon abſolutely to deny, that the ſoking of Corn does not make it fruitful. But I could not believe it neither as unqueſtionable, not being yet certain, whether Nature produced more than one Ear out of one ſingle Corn, (§. 12.) and though that might be; whether in a good Soil many Ears could not grow out of one Grain, without its having lain a ſoking, Nay, becauſe our Author himſelf is ſure of the firſt, (§. 7.) I could not look upon the ſoking any more than upon the dunging of the Land, and conſequently not take it for the only means to bring forth many Ears out of one Grain.

§. 17. This therefore gave me ſtill a greater Curioſity to make an Experiment with ſome Grains.

§. 18.

§. 18. Laſtly, as for what concerns the Cauſe of many Ears growing out of a ſingle Corn, that has lain a ſoking, I found our Abbot's Opinion of it in the beginning of the 7th Chapter. He takes to be true what ſome modern Philoſophers have advanced, and what particularly Mr. *Malebranche* endeavours to demonſtrate in his *Recherche de la Verité* T. 1. B. 1. C. 1. p. m. 38. *ſeq.* that all thoſe Ears which in a thouſand and more Years grow ſucceſſively out of one grain, do exiſt in that very grain perfectly formed, be they never ſo little. According to this opinion, there lies concealed in that ſingle Grain, which this Year is thrown into the Earth, the perfect Stalk with the Ear and all its grains. Moreover there is all the Ears in it, that grow out of theſe Grains the enſuing Year; alſo all the Ears that grow out of the Grains of the ſecond Year, in the third Year; no leſs the Ears that ſprout forth in the fourth Year out of the Grains of the third, and ſo further *in infinitum.* Therefore our Author thinks, that thoſe Grains might be brought forth in one Year, which Nature does by Degrees in more Years, in caſe ſhe is aſſiſted by the ſoking of the Seed, and that the Salt-petre forces out beſides the principal Stalk ſome others, that would not gain ſtrength but the enſuing Years. Nay, becauſe he has perhaps called to mind *Dodart*'s ſeeing many Ears upon one Halm, (§. 11.) he adds moreover, that the capital Halm contains an infinite Number of Ears, that comes only to their full growth in following Ears, unleſs that many of them are expelled in one Year by the force of Salt-petre and the ſaltiſh Particles, they have been ſoking in.

§. 19. I don't doubt in the leaſt, but that a great many are of our Abbot's opinion; for I ſee the ſame Method of reaſoning and explaining natural Effects in moſt of our modern Books about Subjects of Natural Philoſophy. But as for my own part, I muſt confeſs, that when I examined the Argument a little, I found it quite deſtitute of any Foundation.

§. 20. I could not ſee in the very beginning, how from the Petition of ſome modern Philoſophers, that, namely in the firſt Grain of Corn, all theſe little Grains lye buried, that have grown out of it from the beginning of the World to this preſent time, and that will grow out of it, to the end of the World. How, I ſay, our Abbot could infer this Conſequence, that therefore one Year would bring forth, what commonly is to be unfolded by many Years. It ſeems that he has not conſidered the manner of many Ears being one in another, according to theſe Philoſophers. The Caſe is thus: In the firſt Grain of Seed there is but one ſhooting, wherein they pretend, the whole Halm with all the Grains of the Ear lyes, and grows out of it, in caſe the Grain is thrown into the Earth. Each of theſe Grains holds a new Shooting reſembling the firſt, and each Grain of it holds new ones again. Therefore the Ears of the ſecond Year cannot come forth, before the Grains of the firſt Ear are become ripe; alſo the Ears of the third Year cannot grow till the Grains of the ſecond have ripened, *&c.* But if you would bring forth in one Year, what ſhould grow in three or more Years, you muſt render it poſſible for one to ſow, and have a Crop three or more times in one Year.

§. 21. It is not difficult to find the reaſon, why the Ears of the following Year cannot anticipate the Maturity of thoſe of the foregoing. For if a thing has in it many of its own kind, one muſt be ſmaller than the other. If therefore the one Shooting of a Corn contains more within it ſelf, the Shooting of the ſecond Year cannot but be ſmaller than that of the firſt, and the Shootings of the third Year muſt be yet ſmaller, than thoſe of the ſecond, *&c.* So that, becauſe Nature makes no ſudden Starts, but proceeds orderly tho' inſenſibly, thoſe Ears that are far from being unfolded, and have unequal Degrees of perfection to go through, before they come to a viſible growth, cannot come forth in the ſame time.

§. 22. I don't doubt but that it will be alledg'd againſt me, that our Abbot does not admit of innumerable Ears being in one Corn, as I conceive it. But I pretend to ſhew the contrary. For in the beginning of the VIIth Chap. pag. 200. he expreſly affirms, that the whole Art of augmenting of Corn conſiſts in forcing out by Art in one Year, what otherwiſe would be the product of three or four Years. Now there remains of the Growth of the firſt Grain nothing but new Seed, which may produce new Ear again in the next Year; alſo of the growth of the ſecond Year there is nothing ſubſiſting but Grains that are the Seed of the third Year's Ears, *&c.* Wherefore if in the firſt Year there is forced out by Art, what commonly does not come forth but in the ſecond, third or fourth Year, the ſhootings out of the Seed of Corn of the firſt, ſecond and third Year are to grow altogether out of the firſt Corn Seed, by which a Confuſion in Nature is unavoidable.

§. 23. However I was willing to believe that this might have been ſaid, by our Abbot's not being attentive to the manner he expreſſed himſelf in, and that it was his true Opinion, that there was in one ſingle Grain more Halms beſides the capital Halm, which being loſt by the natural way, might be unfolded altogether, provided there was no want of means for it. But I found as much difficulty here as before. For as ſoon as the Leaf of the capital Halm ſprouts forth and takes Root, there remains nothing of the Grain of Seed but an Husk, conſequently no new Halm is to be drawn out of it. I cannot ſay neither that a prepared Grain of Seed ſhoots out as much, as there grow Ears out of it, becauſe, as I have ſeen afterwards; this is not only contrary to Experience, but it is alſo impoſſible that thoſe Halms, which are far more imperfect than the capital Halms, can ſhoot out and grow up equally with them.

§. 24. Having thus reflected on the great Benefit it would be to human Life, and to the better Underſtanding of Natural Philoſophy, if we were certain of a great Number of Ears growing out of one ſingle Grain, and of the Cauſes of it; I took at laſt the Reſolution to enquire into the matter my ſelf, and I flatter my ſelf that I have found out what I ſearched after, it being evident by repeated Experiments.

CHAP. II.

Of the true Cauſe of that prodigious Multiplication in Corn, and of the Method by which it has been diſcovered.

§. 1. I was reſolved to try firſt by way of Experiment, if many Ears would grow out of a ſingle Grain, (§. 13. 17. *c.* 1.) and in caſe it ſhould happen ſo, to enquire into the Cauſe of it. (§. 24. *c.* 2.

§. 2. The next Summer therefore, *Anno* 1709. I put two Grains of Oats into the Earth, in a place expoſed to the Sun all the Day long, where I knew that any thing would grow better and ſooner, than in any other part of the Garden. My chief Reaſon for it was, that the Corn in the Fields has the benefit of a conſtant Sun-ſhine. I did not water the place, but was contented with the Rain and Dew that fell, tho' it was a very dry Seaſon.

§. 3. To the end that I might know, whether the Grain would grow with more than one ſhooting out, and that I might be able to refute ſuch as had imputed the multiplication of Corn to a wrong Cauſe, (§. 23. c. 1.) I looked every Day after it; but I found what I expected, *viz.* that each Grain ſprouted forth no more than one Leaf, as it commonly does in the Fields.

§. 4. My Deſign at that time was to attend no more to it, but to let it grow amongſt the *Cookle* weeds.

§. 5. When I looked at my Halms ſome time after, I ſaw with great delight, that each of my

Grains had brought forth a whole Cluſter, but was very deſirous to know, what would become of the Fruit.

§. *6.* Harveſt being come, I met with a great many Ears brought forth by a ſingle Grain, each of which having a particular Halm of extraordinary Length. The Ears were altogether filled up with Corn, tho' not generally ripe. I obſerved that the Grains were longer and thinner, than what thoſe of Oats in the Fields uſually are. However, trying the Weight of 'em together with ſome of the beſt Oats of the Field with great exactneſs, I found them conſiderably heavier.

§. 7. I then counted all the Ears and Grains; I meaſured the Halms exactly by the Royal *Pariſian* Foot, and determined the proportion of the Weight of the Grains to the Oats in the Field by repeated Experiments. But I cannot be more circumſtantial in this, having loſt the Paper that I wrote it down upon.

§. 8. But this I remember very well, that when I plucked one of the Cluſters to pieces, I ſaw each Halm have his own Root. The Halms were eaſily to be parted from one another, and it ſeemed as if only the Roots were grown together.

§. *9.* I left the other Cluſter in the Ground, at the lower part of which new Halms were coming forth, when it had rained after the Harveſt, which ſhot out into Ears about *Michaelmas.* Moreover, ſome Rain falling ſoon after *Michaelmas*, new Halms below were growing again, ſo that Seed-time and Harveſt came in at once.

§. 10. By this I was ſufficiently convinced, that one ſingle Grain might produce a great many Ears, that yet for all this each Grain has no more than one Shooting, that the capital Halm comes forth out of this Shooting, but that the By-ſhoots proceed from ſome where elſe.

§. 11. Thus Experience confirmed, what my own Meditation furniſhed me with againſt the common Explication of the Cauſe of Multiplication in Corn, (§. 23. *c.* 1.) and therefore the ſoking of Corn loſt a good deal of Credit with me, tho' I ſhall tell my Reaſon elſewhere, why I cannot wholy reject it as yet.

§. 12. Now I was aſſured too, that it would not be amiſs to examine into the Cauſes of more Ears growing out of a ſingle Grain. I knew that there was nothing in the Grain but the capital Halm, and that the reſt of the Subſtance in the Grain of Corn was for its nouriſhment, before it can get any from the Ground by the Root.

§. 13. The By-halms therefore not growing immediately out of the Grain, they ſprout forth either out of the Root or capital Halm.

§. 14. Agreeably to a manner of an Idea's ariſing in the human Mind, which I ſhall treat of at length in my next *Meditations upon God and the Soul of Men*, I knew, that when we are to treat of any ſpeculative Matter, the firſt Idea always begins either with the Contemplation of the thing it ſelf, or of the ſigns by which it is repreſented to the Mind.

§. 15. When I repreſented to my ſelf the Cluſter of Oats, juſt as I ſaw it ſtand in the Garden, I remember'd that all the Ears were grown out of the Earth. When I repreſented to my ſelf again the Condition the Cluſter was in after being pulled out of the Ground, it put me in mind, that indeed every Cluſter had its own Root, but that neverleſs the Roots were grown altogether.

§. 16. Experience ſhews, that not only the EXTRAORDINARY SHOOTINGS come forth out of the

Roots of Trees, and that every By-ſhoot may become a Tree, but that alſo many foreign and domeſtic Plants bring forth ſuch By-ſhoots out of their Root, and by this propagate their Kind. An inſtance of outlandiſh Plants is the *Jucca glorioſa*, the *Aloës* Plant, the *Skrubjeſmin*. An inſtance of domeſtic Plants is *Balm-mint*, *Nettle*, *Sallet-herb*, *Skirret*, &c.

§. 17. I was ſure that as to thoſe Plants that have their Growth from the Root, the Roots ſpread out ſideways, but the Root of my Cluſter of Oats was of a very little compaſs, and conſiſted of but ſmall Fibres. The By-halms therefore could not poſſibly come out of the Root.

§. 18. So there remained nothing but the Halm that had produced 'em, tho' I obſerved that not all the By-halms could have grown out of the principal Halm, becauſe they were not all faſtened thereon; but that always one By-halm muſt produce another.

§. 19. I grew curious to know, how a Halm could produce a By-halm. Repreſenting the Halm to my Thoughts (§. 14. *c.* 2.) I obſerved ſeveral Eyes or little Buttons upon it, and remembered that the Stalk was hollow and empty, that there was no Pith but in the Eyes, and beſides that there was no Eye, but where there was a Leaf.

§. 20. Here I remembered that not only in Trees the Buttons which produce Boughs, grow where there is a Leaf, but that alſo in other Plants By-ſtalks come forth with the Bloſſom where a Leaf ſits. An Inſtance is the *American* Flower of the Sun, which after the Flower of the capital Stalk is decayed, yet throws out By-ſtalks with Flowers, at every place where is a freſh Leaf. I thought alſo of my Method of bringing up *Marjerom*, *Sage*, *Balm-Mint*, *Balm-gentle*, viz. As ſoon as I obſerved that the firſt Stalk by the lower Leaves began to put forth Leaves afreſh, I clipt it to two Leaves, and in a few Days I ohtained two By-ſtalks. When theſe ſprung out again, I cut 'em to two Leaves each, and ſome Days after there grew four Stalks, in the room of which I had afterwards eight, ſixteen, &c.

§. 21. This made me conclude, that therefore no By-halm could have ſprung out of the Halm of Oats, except there was a Leaf, and that this By-halm had taken its particular Root in the Ground.

§. 22. Now I was ſenſible, that it was poſſible to get a great quantity of Ears out of a ſingle Grain of Corn, *viz.* Becauſe the Grain has no more than one Shooting, therefore but one Halm with a ſingle Ear can grow out of it. But in caſe one or two Leaves that are the nigheſt to the Root have the Buttons of the Halm, they are faſtned on in the Earth, or near to it; then theſe Buttons take Root, and a By-halm ſhouts out of the Pith. The capital Halm ſtands upon the horizontal ſuperficies according to a Plumb-line, and the By-halms muſt have the ſame ſtand,and conſequently grow up parallel to the capital Halm.For this reaſon the By-halm muſt firſt decline a little from the capital Halm. That is the reaſon why the By-halm trails along the Ground one or two Buttons, and that two new ones always can grow forth out of each By-halm, as long as there is no want either of ſufficient nouriſhment, or of Rain-water and Dung.

C H A P. III.

Shewing, how the Cauſe of the Multiplication in Corn has been made good by Experiment.

§. 1. I love to ſee any diſcovered Truth in Natural Philoſophy confirmed by undoubted Experiments. For I delight in knowing a thing to be actually Truth, that appeared ſo to me in my Meditation. The ſecond Reckonings that we are uſed to make in Arithmetic, inſpired me with this taſte for Experiments in every thing. For looking upon Arithmetic as a peculiar Part of the Art of Invention, and having learned Mathematicks with no other View, than to get at the Maxims of Meditation; I endeavour'd very ſoon to make uſe of the Maxims of Arithmetick in Natural Philoſophy, as well as in other Sciences.

§. 2. Notwithſtanding therefore that I found no reaſon to doubt of the truth of the Cauſe, I had given for the Multiplication in Corn, having taken nothing for granted but what is founded on Experience, and having proceeded as far as I could remember, orderly in my Concluſions; nevertheleſs I had a Fancy to make particular Experiments with the Corn, in order to aſſure myſelf the more of the truth, as well as others, eſpecially ſuch as have little or no Skill in Reaſoning.

§. 3. When I conſidered then, how I ought to proceed in this Experiment, I remembered, (§. 22. *c.* 2.) that, *Firſt*, I was to put the Grains a little deep into the Ground, at leaſt ſo far that a couple of Buttons of the Halm remained under the Earth, and that I was to obſerve beſides this, whether the By-halm would conſtantly ſhoot out betwixt a Leaf and the capital Halm. I found, *Secondly*, that it would be proper to lay into the Ground one or two of thoſe Buttons that are over it, before they grew hard, to the end that I might ſee, whether they would take Root and throw out a new By-halm. *Thirdly*, That it would be no leſs Advantageous to diſſect carefully a ripe Cluſter, to ſee, how far the lower Buttons of the Halm are off from the Root, and if one Halm was grown on the other near the Button. *Fourthly*, That I was to obſerve, if after the Harveſt a new Seed might not ſtill be produced; and if, *Fifthly*, this Seed could be kept throughout all the Winter, and Fruits be gathered from it the next Year, that at laſt, *Sixthly*, I was to number the Grains and Ears, to ſee the Degree of this Multiplication.

§. 4. I formed this Deſign as Winter was coming on, and when it conſequently could not be executed. Other Buſineſs afterwards hindered me from thinking of it, till the Seaſon was too far advanced again, and I was like to have left it quite off, had I not been encouraged to go on with it by Baron *Leibnitz*.

§. 5. I had acquainted this great Man with my Invention, which he finding to be of conſequence, accordingly adviſed me in his Anſwer not to lay aſide the Enquiry of it, and repeated his Inſtances when I had afterwards the Honour of a Viſit from him at *Hall*.

§. 6. I ordered therefore at the beginning of the Spring 1716, a Caſe to be made for me, and to be filled with Earth out of the Garden. Then I put into it a Grain of Barley and another of Oats, kept the Box within my Bedchamber, and did not ſet it at the open Window, but during the Day-time. Becauſe neither Dew nor Rain could fall upon it, I watered the Earth only with Pump-water, except once or twice with ſome Rain-water that I had caught.

§. 7. The Oats as well as the Barley, came forth with one ſingle Leaf. When the ſecond Leaf came out, the By-halm began to ſhoot up betwixt both. I ſaw the ſame afterwards betwixt the ſecond and third Leaf. In time the By-halms brought alſo forth other Halms.

§. 8. I laid ſome Earth about ſome Halms that were ſhot up high, the Buttons whereof were ſtill quite green, and ſoft, ſo far however that it cover'd one Button, and when I turn'd away the Earth ſome Days after, I ſaw that Button the Leaf was grown on, was burſt open, and had brought forth two Roots, tho' I could not yet diſcover a Leaf. I left another Button longer under the Gtound, and it ſhot out a new Halm.

§. 9. I cannot recall exactly, how many Ears I got by this Grain, but there were not a great many of 'em. I had likewiſe planted ſome Grains in the Garden, where the Oats as well as well as the Barley, did extend itſelf into much larger Cluſters, tho' it happened unluckily, that altogether, except one very large Cluſter of Oats, which was made up of ſome good and ſome blaſted Ears, were pull'd out along with the Weeds, and ſo conſequently were of no Service to my Purpoſe. As for the Cluſter of Oats, I took it out of the Ground before any thing was ripe, in order to examine into my Diſcoveries about the blaſted Corn, which I ſhall enlarge upon hereafter.

§. 10. There cannot be any other Reaſon of the Grains in the Box not growing, as well as in the Garden, lying in the very ſame Ground, and the Roots having room enough to extend themſelves in; but becauſe Pump-water gives not the Nouriſhment, Dew and Rain-water does. I was therefore a little vex'd, that I had got no ripe Grains in the Garden, and could not be ſure of their reſpective Goodneſs by weighing one againſt the other.

§. 11. Parting the Cluſter of Oats, the Ears whereof were partly blighted, I ſaw plainly, that each of this great Number of Halms grew on the Eye of the other, at the Bottom where its Root began, and that its Root had no Communication with the Root of another Halm. The like I obſerved afterwards in the Oats and Barley that were in the Caſe or Box.

§. 12. Thus far I went then in my Proceedings, but expected another Opportunity for the remaining three Articles which (§. 3.) I was to enquire into.

§. 13. And that I might clear up thoſe too, and have an Oportunity to make good by Experiment ſome other things that I ſhall touch upon below, I put ſeveral Grains of Oats and Barley into a Place that had not been dung'd, neither this preſent, nor the foregoing Years: On the contrary I put ſome Grains of Oats into a Bed of Aſparagus, which from the Beginning of the Spring had been filled up with Dirt, and had lain ſpread over it all the Winter long.

§. 14. All the Grains of Barley and Oats in the Ground, that had not been dung'd, brought forth conſiderable Cluſters, eſpecially the Oats had much larger Straw than what it has in the Fields. However the Cluſters of Oats in the Bed of Aſparagus were ſtill greater, and their Ears fuller of

Grains, than thoſe in the Ground that was not dung'd.

§. 15. Sometimes, as I was walking in the Garden, I pluck'd out ſome of the latter Halms. I had a Mind to be fully aſſured of all the By-halms growing out of the Eye of another Halm, and of every ones having not only his own Root, but alſo to ſhew the Juſtneſs of my Invention to ſome that delighted in Natural Sciences.

§. 16. When I once after the Harveſt was over diſſected a large Cluſter of Oats in the open Fields, and in the Preſence of ſome of my Hearers, and counted all the Grains in the Ears, I found above 6000 of great and little Grains; it being known that two Grains are always together in Oats, a large and a ſmaller one. But by Reaſon of the very dry Summer Seaſon, there were almoſt as many of thoſe Halms, that had not begun to grow till in the Dog-days, and afterwards, very little and dried up, as there were of others brought to Perfection.

§. 17. I was indeed reſolv'd to count the Grains and Ears of all the Cluſters that were growing in the Earth, which had had no Dung, but wanting Leiſure for it, and not being eaſily prevail'd upon to take upon truſt what is done by others in Matters of Experiment, I did it but with ſome of 'em.

§. 18. The firſt Cluſter of Barley that fell into my hands, and which was one of the largeſt, tho' not the largeſt of all, held 68 Ears, for the moſt Part ripe, and beſides 21 more, which were not come to maturity, but had been ſtopt in their Growth by extreme dirth.

§. 19. One of the ripe Ears had 32, another 30, five of 'em 29, one other 28, another five 27, another ſeven 26, another five 25, eight 24, as many again 23, ſix 22, nine 21, five 20, three 19, one other 17, one 16, one 13, and another beſides but 9 Grains. The Sum therefore of all the Grains in the ripe Ears, was 1586.

§. 20. Wherefore, becauſe thirty-three Ears had not leſs than 24, on the contrary, thirty-one Ears held not above 23 Grains, we may according to the Rules of Probability that are made uſe of to determine the Chance of Games, ſuppoſe 24 Grains for each of thoſe Ears, that were hindered in their growth. For if according to the ſame Rules, we add 23 to 24, and part the Sum 47 in two, the Product is 23½, for which we may as well put 24, becauſe the Sum of Grains in the plentiful Ears 869 exceeds very much the Sum of Grains in the others 717, particularly becauſe the ſame Sum is produced wholly, if we divide the Sum of all Grains 1586 by the Number of Ears 68. So we may reckon for thoſe 21 Eears, that were burnt up by the exceſſive Heat, 504 Grains, which without any doubt would have become ripe as well as the reſt, if it had not been for the aforeſaid Heat of the Seaſon. Now if we add theſe 504 Grains to the firſt 1586, the whole Sum of Grains is 2090, that one ſingle Grain of Barley has brought forth in a good Soil, tho' not dung'd at all.

§. 21. Obſerve, that thoſe Ears which had not many Grains, where not come quite to Perfection, witneſs the ſcorch'd Hulls, that one could plainly ſee in many of 'em, for inſtance in thoſe that had 9, 13, 16 and 19 Grains. The Cauſe hereof was nothing elſe as I ſuppoſe, but the conſtant Dirth, want of Dung, and neceſſary Nouriſhment.

§. 22. I took out afterwards the ſmalleſt Cluſter of Barley in appearance, which had no more than thirty-ſeven ripe, and twenty-ſix green Ears. Here it was plain enough to be ſeen, that thoſe Ears which had 16 or 20 Grains, were dried up at the upper end, having Hulls inſtead of Grains, which confirm what I mention'd juſt now (§. 21.) about the Cauſe of ſome Ears having leſs Grains than others.

§. 23. One of the ripe Eears had 32, three of 'em 29, one 28, three 27, four 26, one 25, five 24, one 23, four 22, two 21, ſix 20, one 19, two 18, one 17, and two 16 Grains. Agreeably to this the Sum of all the ripe Grains was 854.

§. 24. One Moiety of the Ears, juſt as before, held not under 24, and the other Moiety not above 23 Grains, and nevertheleſs the Sum of Grains in the plentiful Ears 477, is conſiderably greater than the Sum of Grains of the other Ears 377. Therefore we may again reckon for each of thoſe 26 Ears that could not grow ripe becauſe of the exceſſive Heat, 24 Grains, conſequently for the whole 624. Adding theſe 624 Grains to the firſt 854, we get a Sum of 1478 Grains, that one ſingle Grain of Barley may produce in a very ſmall Degree of Fertility.

§. 25. That I might experience the Quality of my Barley, I have weighed it with other Barley, and found, that notwithſtanding mine was much drier than the other, 28 Grains of my Barley ſtood equilibrious to 31 Grains of the other Barley, in a very exact Steel-yard. If 28 Grains of my Barley had been equilibrious to 30 of the other, the proportion of the Goodneſs of my Barley to that of the fields would be, as 14 to 15, and conſequently better about $\frac{1}{15}$. But 28 Grains of my Corn weighing as much as 31 others, the Difference is ſtill greater than $\frac{1}{15}$.

§. 26. The Goodneſs of my Grains conſiſted in their being more ſolid and compact than the others.

For

Fot tho' they ſeem'd indeed to be ſmaller, yet they were of more weight. And when I look'd through a Microſcope upon a Slice of both Sorts of Grains, I obſerved that the little Lumps which they are made up of, were much ſmaller in my Grains than in the others. This too makes me believe, that my Grains would have made a finer Flower; for I ſuppoſe it to be known, that a Flower repreſents itſelf in a Microſcope like unto a great many little Bubbles.

§. 27. The By-ears had ſhot out much higher than the common Barley does in the Fields. But however, there were Ears of the ſame Length, each having five Buttons, the Diſtances from one Button to the other were not equal.

§. 28. The moſt remarkable of all was, that a By-ear had brought forth a little Halm of near two Inches long out of the next Button to the Root, tho' it ſtood about an Inch from the Ground, and could not take Root; but this Halm was quite burnt up by the Heat. On the contrary, on another Ear I met with an Halm that had a good Ear, and was likewiſe grown out of the next Button to the Root, and yet ſtood above an Inch from the Ground, ſo conſequently was not able to take Root. The Halm conſiſted of no more than three Buttons, tho' it was above an Ell long up to the Ear, I counted 24 ripe Grains in it, that were as heavy and ſolid, as ever thoſe in the Capital Ears could be. Beſides ſome Hulls were dried up for want of Nouriſhment.

§. 29. By this it is clear, that each Ear would at leaſt bring forth one By-ear without a Root, if there was ſufficient Nouriſhment for it, and beſides makes good what has been ſaid above (§. 11. *c.* 1) about many Ears being in one Halm.

§. 30. I could after the ſame Manner enlarge upon ſome Cluſters of Oats. But becauſe a cloſe Examination of 'em would be too troubleſome, and that the large Account about the Barley, will make one judge of the Fertility in Oats, I won't mention every Circumſtance of it.

§. 31. However, I cannot paſs by without mentioning, that I left the Roots and Stubbles of ſome Cluſters of Oats in the Ground, to ſee if the Stubbles of the latter By-ears that look'd green below, tho' the Ears of 'em were quite ripe, would not break out a freſh. Going into the Garden the 17th of *December* when the Weather was mild, I found new Cluſters of little Halms by 'em, and a great many Shootings out.

§. 32. I don't doubt, but that if it had been Rye, or Wheat, the Seed of it could have been kept during the Winter, and would have brought forth new Fruit the next Year. Nay, I am of Opinion, that the Shootings out, that one had kept the Winter, might be diſſected and laid otherwiſe, and ſo that the Shooting out would grow again into a whole Cluſter. Every one will ſubſcribe to this, who conſiders what has been ſaid (§. 22. *c.* 2.) about the true Cauſe of many Ears growing out of a ſingle Grain. If any Body would be pleaſed to make an Experiment with Rye and Wheat, he might try this too at the ſame time.

CHAP. IV.

Of blighted Corn.

§. 1. IT happens very often, that the Grains in the Ears of Wheat grow as black as Coals, and afterwards, always ſofter and ſofter, 'till they are reduced at laſt to a black Duſt, that is as fine as Flower. We ſay then, the Corn is *blighted.*

§. 2. Sometimes Barley is blighted too, tho' there is no mention made of it in a great many Books about Husbandry. I once obſerv'd it in the Oats during my Experiments, and found that *Chomel* in his *Dictionaire Oeconomique* under the Word *L'Avoine Sauvage*, or wild Oats, alledges the ſame.

§. 3. One meets with a great many Remedies againſt this inconveniency in Books about Husbandry. But *Florinus* in his *Skillful Country-Man*, compares it not improperly to the Toothach. No Plague has more Remedies, ſays he, than this, but never were Remedies leſs ſucceſsful than here. I am much afraid, that his own Preſcriptions are of the ſame Nature.

§. 4. The Reaſon of their given ſuch improper Preſcriptions againſt the blighting in Corn, is, that a true Definition of it has been wanting. Having no right Notion of the Thing itſelf, ſeveral have taken wrong Meaſures, ſearching after the Source of it.

§. 5. I find in Books of Husbandry, that ſome aſcribe the Cauſe of the blighting in Corn, to a blaſting Miſt; others to a corrupted Seed: tho' the latter don't agree, whether the Seed is ſpoil'd out of the Ground, or under it, nor about the Cauſes in either reſpect.

§. 6. *Chomel* on his *Dictionaire Oeconomique* takes the blaſting Miſt to be the only Cauſe of the blighting of Corn, and undertakes to ſhew the Manner of it, under the Words *Bruine* and *Froment* (tho' in both Places with the ſame Words) without being ſure before Hand of undoubted Experience for it. He thinks, that the Miſt is changed ſometimes into an oily or greaſy Kind of Stuff, which falling upon Grains burnt up by the Sun grows ſo hot, that the Grains are juſt as if they had been roaſted.

§. 7. Who does not ſee that this Explication is without any Foundation, and ſomething unintelligible? For he ſuppoſes without any Reaſon, that the Miſt is chang'd into a greaſy Kind of Stuff, ſuch as Oil or the melted Fat of Beaſts is, fit for the Roaſting of ſome-thing, without taking any notice, whether it be his Opinion, either that the Grains retain ſo much heat from the Sun during the Night, that they can make a greaſy Stuff's falling upon them ſeething hot, a Degree of Heat neceſſary for the Roaſting of any thing, or if it is to be underſtood, that the cold greaſy Miſt grows hot upon Grains burnt up by the Sun, but cold again at Night, in ſuch a Manner perhaps as cold *Terebinthine Oil* does, when mix'd with *Copperas*. But which ſoever of both Opinions, *Chomel* may chuſe to be his (for a third Opinion cannot be allow'd), yet he preſumes ſomething without a Proof.

§. 8. It is never difficult to ſhew, that an Opinion is without Foundation: For one needs but diſcover the Suppoſitions that are deſtitute of Proof. But to prove inconteſtably, that a thing ſuppoſed without Proof, is impoſſible, is ſometimes impracticable for want of ones ſufficiently knowing the Faculties of Nature. That's the Reaſon, why obſtinate Men, that have no taſte for perſpicuity or

Demonſtration, very hardly abandon their Opinions. For the common Rule: *He that affirms any thing is oblig'd to prove it*, does not ſerve ſo much to make another quit his Opinion, as it does to make one careful not to admit of any Thing without a Foundation.

§. 9. I need not enlarge upon the Refutation of what has been ſaid to maintain this falſe Opinion, which will prove ſo hereafter without that; tho' I dare ſay, that according to the Rules I have given *c.* 4. §. 7. *p.* 59. in my *Reflections upon the Faculties of the human Intellect*, it is impoſſible, that good Grains ſhould become blaſted by roaſting. For a blighted Grain is ſoft and without any Pains rubb'd into an extraordinary fine Duſt; but every thing roaſted in Fat grows hard and compact. A blighted Grain hath not the leaſt greaſineſs on it; but every thing that is roaſted in Fat, is greaſy too. A blighted Grain is full, but any thing roaſted in Fat ſhrinks.

§. 10. Neverthelefs, if any body ſhould be deſirous to know, what has occaſion'd this ill-grounded Opinion of *Chomel*'s, I could eaſily and at large ſhew it him by virtue of thoſe Rules, which human Thoughts are directed by, and which will be publiſh'd ſhortly in my *Reflections upon God and the Soul of Men*. I ſhall tell it in a few Words. *Chomel*, who has publiſh'd a Book about Husbandry, in all likelihood had either read in other Books of this Kind, or had been told by Husbandmen, that Corn grew blaſted, when a Mil-dew or Honey-dew falls upon it. Now he has ſeen that blaſted Grains look black, and like unto things reduced to Duſt, and therefore he concludes, that a Mil-dew burns the Good Grains of Corn. His *Dictionaire Oeconomique* ſhews that he underſtood Kitchen-work. This has put him in mind how Victuals are over-roaſted and grow black in melted Butter or Fat, which made him believe again, that the Grains are roaſted by a Mil-dew. And becauſe Fat muſt be hot for to roaſt any thing in it, and knowing that every thing that is expos'd to the Sun, grows very warm, beſides, that a hot Body heats all liquids it lies in; one ſees without difficulty the Offspring of his other Reflections.

§. 11. One *Becher* in his *Skillful Husbandman*, and *Florinus* l. 2. (§. 3.) muſt have look'd upon the ſpoil'd Seed as a Cauſe of the blaſting in Corn. For they think too, it may be prevented by waſhing the Seed in very clear River-water the Day before it is ſown. It is their Opinion too, that the Seed is not ſpoil'd by any thing in the Earth, but rather by an impurity of its own. All thoſe that pretend, that Wheat is blaſted, when the Seed is put into a Sack that Flower has been in, muſt needs be of the ſame Opinion. On the contrary, thoſe that mix Aſhes with the Seed two Days before the ſowing, in order to prevent blaſting, cannot but fancy that the Seed is corrupted by ſomething under Ground.

§. 12. All theſe cannot but rely upon Experience. But I have demonſtrated in general in my *Reflections upon the Faculties of human Underſtanding*, c. 4. §. 11. p. 64. that one thing is not always the Cauſe of the other, tho' they follow one another; for it may happen accidentally in the above-mentioned Caſes. 'Tis true indeed, that by this their Opinions appear only to be uncertain, not entirely falſe; but I don't pretend to any thing but to ſhow, that they have overhaſten'd themſelves. For according to what I have ſaid in the aforeſaid *Reflections* p. 65. it was their duty to examine the Caſe cloſer. For inſtance, when they want to know if Wheat was blighted by Flower (which I don't judge to be the Caſe) they ought to put ſome Grains of Seed into Flower for ſome Days, and ſo have lain 'em under the Earth ſeparately.

§. 13. It would be a very great Improvement in Agriculture, if the Nature of this Corruption in Corn was evidently known. I fancy therefore, that a Deſcription of my Diſcoveries concerning blaſted Corn, cannot be diſagreeable.

§. 14. I had the good Luck, when I began my Experiments with the Corn 1716, and which I made mention of heretofore, to get good and blighted Ears out of a ſingle Grain, put into a Box filled up with Earth, that I kept all the Night in my Bedchamber, and expoſed only to the open Air during the Day-time, ſo that neither Rain nor Dew ever touched it. The Capital Ear, that the Grain had produc'd, yielded nothing but good and ſound Grains. One of the two firſt By-ears was good too, but the other was blaſted. The ſound By-ear ſhot out again into other good ones; but the blighted Ear brought forth other blighted ones out of the Button of the Stalk, that touched the Ground. Nay, I obſerved, that thoſe Ears were blaſted already which lay yet very deep in their Husks when there was nothing of any Corruption to be ſeen in the Leaves of the Halm, which I ſhall explain more particularly.

§. 15. This proves at leaſt, that Corn is not blighted by any Sort of pernicious Dew, becauſe my Ears were blighted without being affected by any Dew. We cannot ſay neither, that a Sort of Dew might fall in a Bedchamber, when the Air being contracted by the Coolneſs of the Night, the compreſſed Vapours change into Drops, becauſe not only Experience is againſt it, having never met in a Morning with any Dew upon the Leaves of my

Cluſters of Barley or Oats; but alſo becauſe this Dew would have ſpoil'd the outward Sides of the Leaves, before it could injure the Ears cover'd as yet with ſo many Leaves, and which having no perceptible Grains, lay concealed in a little Shell. On the contrary, I have obſerved that, though the Leaves of the Oats became ſpeckled, and were cover'd with a Kind of Moſs under the Spots on the wrong Side, as mouldy things do, yet the Ears and Grains ſuffer'd nothing by it, whereas on the other Hand, the Halms that began to ſhoot up, faded away.

§. 16. When the blaſted Ear came forth, there was a conſiderable Difference in the Beards, which Grains of Barley have. For as they are naturally long, ſtraight, and green in good Ears, here they proved ſhorter and crooked like the wriggling of a Snake, and of a whitiſh Colour; which were the Circumſtances that made me perceive betimes that they were blaſted.

§. 17. The blaſted Grains were fuller than the good ones, tho' for the moſt Part black and ſpeckled, and green in but very few places. Their Figure differ remarkably from that of the good Grains. For the blaſted Grain was divided into three Parts upwards to the Beard, juſt as if ſome more Grains would come out on both Sides the Top, or as if three Grains were growing one into another. The Microſcope eſpecially ſhew'd plainly that a blaſted Grain of Barley is a three bodied monſtrous Production. Becauſe all the Grains in the blaſted Ear were of the ſame Figure, I went into the Fields, where finding a vaſt many blaſted Ears of Barley, I obſerved that the Grains were of the ſame Shape with my blaſted Grains.

§. 18. It happen'd very conveniently, that there was a large Cluſter amongſt the Oats, I put in the Garden, with a great many blaſted Ears together with young By-Ears, Halms, and Shootings out. For this gave me an opportunity to examine the Ears as to their Degrees of Bigneſs, which were quite different. I diſcover'd not only by the Help of good Microſcopes, a deform'd Figure in the Grains of young Ears, that were quite hidden, but alſo little black Spots here and there. This induced me to diſſect a By-ſhoot from the blaſted Barley Ear, and to pick out the Ear of it, I found particularly in the Beards ſomething black, that filled up the whole Concavity, juſt as when a Pipe is choaked up. For the better Underſtanding of this I muſt obſerve to you, that the Beards of Barley look like a Pipe through a Microſcope.

§. 19. Thus I ſaw evidently, that blaſted Ears are nothing but extraordinary and preternatural Productions. And becauſe fluid Matter ſpoil when their Current is ſtopt, the radical Moiſture which circulates in all Plants, being hinder'd in its Circulution by an ill ſhap'd Figure, muſt corrupt.

§. 20. As to the Cauſe of Nature's producing monſtrous Corn, I cannot determine that at preſent. For it is not my Cuſtom to forge any thing in the Explication of natural Effects, but I always ſtop where Experience and evident Truth leaves me.

§. 21. However one may ſee, that there is no ſuch thing as yet as remedying the blaſting in Corn, but that more Experiments muſt be firſt made, for the finding out of the true Cauſe of preternatural Productions.

CHAP. V.

Which ſheweth, how this new Invention may improve Husbandry.

§. 1. ACcording to my Experiments of the preſent Year, the pooreſt By-ears of a Grain of Barley that yielded the leaſt of all, had never leſs than 16 Grains; tho' becauſe of the uncommon Heat of the Seaſon, the upper Hulls were burnt up and empty. Which manifeſtly ſhews, that the Ears would have afforded a great many more Grains, had it not been for want of Nouriſhment.

§. 2. The moſt plentiful Ear in two Cluſters of Barley, that is to ſay, of 152 Ears, yielded 32 Grains, and the next to this in a Cluſter of 89 Ears, 30 Grains.

§. 3. A Grain of Barley therefore, tho' it produced but one Ear, muſt yield thirty-fold Fruit in a good Soil, and fine growing Weather. It muſt multiply ſixteen-fold, if the Weather does not ſerve (§. 1).

§. 4. All the Roots of the Ears in a Cluſter, being very near to one another (§. 17. *c.* 2.) the worſe By-ears in a good Soil cannot have a better Situation, than the capital Ears have in a bad Soil. Therefore, becauſe the worſe By-ears have 16 Grains in bad Weather (§. 1.) and that the leaſt fruitfulneſs is one half of the greateſt (§. 3.) I don't think, that I am out in ſaying, that a Grain of Barley yielding but one Ear, muſt multiply ſixteen-fold in a bad Soil and good Weather, and but nine-fold when the Weather is bad.

§. 5.

§. 5, This I preſume to be the Caſe only according to all likelihood; for I am not allowed to enquire into every thing by exact Experiments. However I fancy, that I have not reckon'd too much, nay, that I have even Experience itſelf on my ſide. For I don't doubt but that we may juſtly compare an Ear which ſhoots forth among threeſcore, that were grown altogether, out of a ſingle Grain, and which is burnt up by the great Heat, to one that grew ſingly out of one Grain, in a bad Soil and when the Weather was bad. But my Experiments ſhew, that an Ear of the firſt Sort had nine Grains.

§. *6.* If therefore all the Grains that are thrown into the Earth did come out, and if one Grain did produce but one Ear; one Buſhel of Grains in a fruitful Soil and good Weather ought to yield 32, but in bad Weather *16* Buſhels, and a Buſhel in bad Soil and good Weather, would yield *16*, but in bad Weather nine Buſhels.

§. 7. I am ſure that it has been reckoned a good Harveſt in a fertile Country, when one Buſhel of Seed has yielded nine, which ſhould have yielded 32. (§. *6.*) This proves that hardly a third Part of the Seed turns to Account, and that the other two Thirds are loſt.

§. 8. Tho' a Ground is not dung'd, and the Seaſon is ſo very dry, that the Graſs is burnt up every where, yet one Grain that yields the leaſt, will give 37 ripe Ears, and another that's more fruitful, 68 Ears. On the contrary there grows commonly but one Ear out of a Grain in a plentiful Crop, and good Soil that is well dung'd.

§. *9.* In a dry Summer, as that I ſpoke of, one fruitful Grain may produce 1500 Grains, and conſequently one Buſhel of Barley Seed 1500 Buſhels (§. 19. *c.* 3.) but a Grain that yields the leaſt among a great a great many; may yield above 860 ripe Grains, and one Buſhel of Barley above 800 Buſhels (§. 23). But commonly one Buſhel hardly gives nine (§. 7.) and therefore not the hundredth Part, nay hardly $\frac{1}{150}$ of what it might give.

§. 10. Hereby it appears how far Husbandry might be yet improved, it being poſſible that the Land might yield a hundred Times as much as it does now.

§. 11. As for the Method of putting the Seed under Ground, to make ſuch a plentiful Harveſt, it may be eaſily diſcovered out of what has been ſaid (§. 22. *c.* 2.) about the true Cauſe of the Multiplication in Corn. If a Grain is to produce many Ears, ſome Buttons of the Halm muſt needs be under Ground (§. 22.) and therefore the Seed muſt lie deep in the Earth, about an Inch; for then two Buttons of the capital Halm remain under Ground. And to the end, that the By-ears may have room enough to ſpread out, and not want Nouriſhment, the Grains muſt lie at ſome diſtance from one another.

§. 12. According to theſe Maxims I made a Trial laſt Summer with Oats and Barley, putting the Grains about the third Part of a Foot, or a little above three Inches from one another. Every Grain of Oats as well as Barley, ſhot forth into a whole Cluſter. Theſe were thoſe Cluſters of Barley, which I have given a large Deſcription of (§. 18. *c.* 3).

§. 13. It appears by this, how it comes to paſs, that ſo much of the Seed is loſt (§. 7.) why one Grain ſeldom gives more than one Ear (§. 9.) and why conſequently the Field produces ſo ſmall a Matter, when Nature might do infinitely more (§. 10). For as the Field is manured now, the

Grains are not ſown deep enough, nor far enough from one another.

§. 14. The Seed not being uſually covered at all, or very little, great Part of it is carried away by Birds, which may be prevented by the Grains lying an inch under Ground, and ſome inches from one onother; it being then Difficult to get at 'em without routing about the whole Field.

§. 15, Again, the Seed lying bare or little cover'd, and dry Weather coming in, which uſually ends in a high Wind, great Part of it is blown into the high Road and troden down.

§. 16. The Seed not being well cover'd, is alſo more ſubject to other Changes of Weather, than that which lies deep under Ground. For inſtance, when after much Rain by which the Grains are ſwelled, tho' not ſhot out yet, cold Weather comes in, they muſt fret and burſt. Likewiſe, when the Grains begin to ſhoot out, and the Weather proves dry ſoon after, the young Roots very eaſily dry up, and the Corn goes out. Not to ſpeak of other Accidents.

§. 17. The Seed not lying deep may eaſily cauſe a Want of neceſſary Nouriſhment to the Corn, becauſe the upper Part of the Ground is ſooner dried up by the Sun and Wind, than the lower. For when the Weather happens to be dry, and the Corn is a ſhooting and bloſſoming, the upper Part of the Ear is ſtopt in its growth, and has but little Grains; to ſay nothing of the Grains that don't ſucceed, their not being ſolid, and conſequently not ſo heavy as the Grains of thoſe Ears, which have deeper Roots. (§. 25. *c.* 3.)

§. 18. When the Grains of Seed lie too nigh to one another, one leſſens the Virtue of the other for want of neceſſary Nouriſhment. By theſe means the By-ears are miſſing, and the capital Halms are not ſo good as they would be, did they never fall Short of Nouriſhment. Obſerve, that Rain-water will not do alone to give due Nouriſhment, but that the ſaltiſh and ſulphureous Particles of the Dung muſt likewiſe come into it.

§. 19. It is true indeed, that I have made my Experiments in the Garden and not in the Fields, and that there is a great Difference between both. For in the firſt Place, the garden Ground is commonly better than that of the Fields, next, the Air ſtrikes more thorough the Field and dries it ſooner up, than in a Garden; laſtly, the Sun darts his Beams more and longer upon the open Field than upon Gardens, they being generally ſhaded by Buildings or Trees, which has this Effect, that their Soil grows not ſo dry as that of the Fields.

§. 20. Thus it appears, that no ſure Conſequence can be drawn from the Plentifulneſs of Corn in a Garden, to that of the Fields. For the Corn grows better in a good Soil than it does in a bad, and when the Soil is ſoon dried up, it wants Nouriſhment, which hinders the By-ears from gaining ſtrength.

§. 21. You may obſerve another difference too, *viz.* that garden Ground is more ſpungy than that of the Field, which makes the By-ears take Root more eaſily. Beſides the Roots ſpread wider in a ſpungy than in a hard Soil.

§. 22. I won't deny, but that there is ſomething in all this, but muſt confeſs, that the Fruitfulneſs in the Field, may be leſs than in a Garden, for the afore-mentioned Reaſons. But Experience itſelf makes me look upon it as being of little Weight againſt my Aſſertion. For looking about in the Field, I have met here and there, eſpecially nigh the Road, with Cluſters of Ears that were grown out of a ſingle Grain, as I could gueſs from the likeneſs they bore to my Cluſters of Oats and Barley. And when I, after the Harveſt was over, examin'd the Stubbles in the Field, I obſerved again, that Cluſters of Ears had been in thoſe Places, where the Seed had lain very thin; but that the Halms were little, and the Ears of 'em very poor, where two Grains of Sead had lain together.

§. 24. It would be worth one's while to make Experiments upon all Sorts of Ground ſome Years together, to obſerve diſtinctly, and with certainty, the Difference of the Faculties of Nature in different Grounds, and in different Diſpoſitions of the Air; the Matter being of ſuch Importance, that not only the Rents, but the intrinſick Value of Lands might be raiſed, in Caſe the Increaſe of Corn was carried to ſo high a Degree.

§. 25. But others may enter into theſe Occupations, that have more leiſure and oportunity than I have, and that are more concerned too in the Improvement of Husbandry. I am ſatisfied with having proved, that infinite Ears may grow out of a ſingle Grain, beſides the new Seed it produces; provided there is no Want of thoſe Means, by which the Growth is advanced, *viz.* of Warmth, Nouriſhment, and a pure Air, and with having ſhewn, how this is poſſible.

§. 26. I know very well, that thoſe, who have a great many Fields to till, and who direct their Thoughts only upon getting of Money, will hardly like my Invention. For they don't care much for a Science, which teacheth them the Faculties of Nature, becauſe the getting of Money is not immediately annexed to it, and they cannot ſee as yet, how to make any other Uſe of my Invention, than to make the Ground very looſe, and to put the Grains of Seed ſeparately into it, which Labour I would not advice 'em myſelf to go through. I ſhould do them a more agreeable Piece of Service, if I could propoſe a Way to get a thouſand-fold Crop by the uſual Labour that's beſtowed upon the the Field; and then they would not deſire to know the Secret, how Nature can afford it, but be willing to ſubmit their Reaſon to the Direction of their Senſes.

§. 26. I don't queſtion their being in the Right; for I ſhould think the ſame, if I had no better inſight into Nature, or live under their Circumſtances. It would indeed be a greater Advantage to Mankind, if they could obtain ſuch a Bleſſing with their uſual Labour, or an equivalent trouble, than if they knew only that the faculties of Nature are infinite in the Multiplication of Corn, and in their Manner of exerting themſelves.

§. 27. But after premiſing of this I muſt ſpeak too in my own Way. I have proved, that an inexhauſtible treaſure lies hidden in Nature, and have ſhewn the Place were it is to be found, together with the Means how to get at it. So there remains nothing but to think of making thoſe Means more feaſable. No-body will diſpute, but that there is now more Hopes of finding out the Treaſure, than there was before any ſuch thing was known to exiſt, or at leaſt nothing was known of the Place, where it was to be ſearch'd after.

§. 28. I don't ſay too much; every body will allow this, who has read all the foregoing Pages with a due Attention. It is proved by exact Experiments, that a great Number of Ears having ſome thouſands of ripe Grains, will grow out of a ſingle Grain of Seed, without any Preparation either of the Seed or the Field for it, tho' the Diſpoſition of the Air be not the beſt (§. 16. *c.* 3.) I have found by reflecting on (§. 22. *c.* 2.) and afterwards confirmed by Experiments (§. 14. *c.* 3.) that a new Ear comes forth out of every Eye of the Halm before it grows hard, provided it touches the Ground. Laſtly it is made evident not only from theſe principles (§. 11.) but alſo from particular Experiments, that ſome Eyes of the Halms and By-halms may be brought to take Root, and that therefore a ſingle Grain gives a whole Cluſter of Ears. Becauſe it would be too troubleſome as well as chargeable to put the Grains of Seed ſeparately into the Ground (tho' it may happen to be worth while) the Caſe is, to think of an Alteration in the uſual Inſtruments made Uſe of in Husbandry, or to make others in their Place, that are more commodious, and fit to place the Grains deep enough under the Earth, and far enough from one another.

§. 29. There is no doubt of ſucceeding in this, if he that undertakes it has but ſome Knowledge of Agriculture and Skill in Mechanicks. Nay I believe, that experienced Husbandmen will make ſome Uſe of my Invention even in their cuſtomary Way to till the Field, taking Care that the Seed is not thrown to thick, and that the Field is harrowed over better than what is commonly done. They will ſoon find out means to go farther, if they will but mind it. Perhaps I may gain time and opportunity myſelf to be uſeful in this Point, provided I am not prevented by another.

§. I find in the *Philoſophical Tranſactions* N°. 60. p. 1056. that a *Spaniſh* Author *Don Joſeph de Lucatello*, has diſcovered and acknowledg'd the true Defects in Husbandry, tho' not out of a true Principal. He takes for a Maxim, what the antient as well as the modern Huſbandmen, have ſet a great Value upon, to wit, that Plants muſt be placed far enough from one another, and their Roots put deep enough into the Earth, to the end that the Roots may ſpread, and have no Want of Nouriſhment.

§. 31. Experience ſhows, that the Root of Corn does not ſpread in Breadth, and I have found in the Courſe of my Experiments, that the By-halms of Oats, that had ſhot up two Ells high, were as big again as a Corn-halm in Diameter; that an Ear of 'em held 129 double, or 258 ſingle Grains, and one Cluſter 15 perfect Halms with ripe Ears, which were for the moſt Part accompanied by imperfect ones, and that notwithſtanding this, they had taken very little Root. The Roots of all thoſe Ears in the Cluſters had not ſpread two Inches, and the longeſt Fibers had grown downwards not above three Inches. Therefore, if it was not for the ſake of the By-halms, the Grains need not be above half an Inch from one another, nor need they be deep under the Earth, becauſe in my Experiments the By-halms, that had taken Root quite above the Ground, yielded their Fruit as well as the others.

§. 32. I don't wonder therefore, that the Maxim of *Lucatello*, who had no good Reaſon to conclude from gardening, that it muſt be ſo too in Agriculture, has not been minded by others. For I would not have admitted of a Conſequence taken from Plants in a Garden to Corn in the Fields, ſeeing no ſufficient Reaſon for it; ſo much the leſs, becauſe according to the common Opinion, a great Diſtinction has been alway made betwixt Corn, and things that grow in a Garden. For other Plants grow either in breadth or in ſhrubs, but moſt People have believed hitherto, that one Grain of Corn produced but one Ear; not to mention again, that the Root of Corn does not ſpread itſelf far.

§. 33. Nevertheleſs, it would not be well done for the Future, quite to neglect this Obſervation in Matters of Agriculture, after it has been proved from a thorough Knowledge of Nature, and by infallible Experiments, that a Grain of Corn may grow up in a Shrub, if it is deep enough under the Earth, and not lies to near other Grains.

§. 34. *Lucatello* has propoſed in the above-mentioned Place, an extraordinary Sort of a Plough, which beſides its breaking the Ground, ſtrews the Seed in the mean Time. He has made an Experiment with it in *Auſtria* in Preſence of the Emperor, and effected that thoſe Fields which yielded four or five Fold before, render'd afterwards ſix-fold Fruit. But this Multiplication of Corn is very inconſiderable in Compariſon of what I have ſeen in my Experiments, and I doubt very much, whether his Plough can be of any ſervice in Fields, that are not quite level.

§. 35. I would adviſe a Man, before he undertakes to find out Means of getting the Grains duly and at a convenient Diſtance from one another under the Earth, without great trouble and loſs of Time; to make firſt an Experiment in a little Corner of his Fields, with a handful of Seed by putting the Grains into the Earth as we are uſed to do with Cucumbers or Beans, that he might experience what his Field will afford, and by obſerving the Root and whole Cluſter, know, at what a Diſtance and how deep the Grains ought to be laid in his Ground.

§. 36. I would have him take one Half of the Seed and let it ſwell in Dung-water, and ſo put it ſeparately from the reſt into the Earth to ſee if there is any other Difference beſides the latter's growing quicker; it being known, that all Seed which is ſwelled up, grows ſooner than other Seed that's quite dry.

§. 37. I have mention'd above, that I take the Soaking of the Seed to be *probably* an advantagious Dung, not having as yet been able to make the ſure Experiment thereof (§. 16. *c.* 1.) I muſt therefore only ſhow this ſtill.

§. 38. When Dung and other before enumerated Things (§. 15. *c.* 11.) lie putrifying in Rain-water, the ſaltiſh and ſulphurous Particles, which are required to change Water into good Sap, are communicated to the Rain-water. If the Seed lies a ſoaking in it, it partakes of thoſe Particles which makes it ſhoot forth quickly. When the Grain is rotted, the Matter remains about the Root, and is communicated afterwards to the Rain-water, which penetrates into the Root. Accordingly there is a good deal of this Matter together in a little Place, which elſe would lie far and divide about the Field, and could not get in ſuch a Quantity into the Seed, and afterwards into the Halm.

§. 39. No Body muſt fancy, that theſe, and all the foregoing Obſervations are the laſt that can be made for the Improvement of Agriculture. There are a great many Things of this Kind more, that want to be examin'd into and illuſtrated: Theſe are but the Beginning of an Improvement, and a Manuduction to further Enquiries.

CHAP. VI.

Which ſheweth the Uſe of this Invention in the Explication of Nature.

§. 1. I Had no ſooner diſcovered the true Cauſe of Multiplication in Corn, which is, that in every Eye where a Leaf ſits, there is a Shooting with a Root; but I got quite different Notions of ſeveral Things from what I had before, eſpecially relating to the Growth of Plants.

§. 2. I called to Mind not only that Eyes come forth in Trees where a Leaf is, and that it is the ſame with the By-ſtalks in other Plants (§. 20. *c.* 2.) but I know alſo, that Nature is the ſame in all her Operations as much as is poſſible. Therefore I had no Reaſon to doubt, but that there is an Eye in all Plants where a Leaf is, which may take Root and ſpring up, in caſe the Stalk and Leaf touch the Ground.

§. 3. And that I might be the more confirmed in my Opinion, I looked diligently about in the Gardens and Meadows, obſerving the Places where all Sorts of little Trees and Plants throw out their By-ſtalks; likewiſe where the Sprouts of thoſe Plants come forth, that multiply by growing above the Earth, as *Strawberry's* and *Crowfoot* do: But I found conſtantly that nothing in any Place came forth but where there was a Leaf, or had been before. Nay, upon a cloſe Examination I ſaw, that Nature acts after the ſame Manner in bulbous Plants; for Inſtance, in *Tulips* or *Lillies*, as I ſhall deſcribe at large another time.

§. 4. I preſſed alſo ſome Stalks of *Marjerom* and other Plants on a mouldy Earth, which took Root wherever a Leaf ſat, and produced particular Sets of their Kind, that could be cut off afterwards and be tranſplanted.

§. 5. When I *Anno* 1707 inoculating young Sprigs, looked cloſer upon the Eyes, and conſidered all Parts that could be diſſected by good Microſcops, I obſerved that every Eye has its own little Root, by which it gets Nouriſhment. And this made me conclude, that if the Eye is to grow by Inoculating, the little Root muſt not be hurt.

§. 6. I did not think then but that *Malpighius* or *Grew* in their *Anatomiæ Plantarum* had obſerved, that every Eye has its particular Root, by which it receives the Nouriſhment coming up through the Bark. And for that Reaſon I mention'd it as a Thing commonly known in my Diſſertation *upon the hard Froſt* 1709. *Sect.* I. and §. 25. *p.* 26. giving a Deſcription of the little Root in thoſe Eyes that were not frozen, but continued to ſpring up. But looking now for it in the aforeſaid Books, I find nothing of the Matter, which makes me believe, that they hurt the Eyes, when they examin'd the Structure of 'em.

§. 7. Becauſe the Eyes in Trees, and other Plants, are nothing but a Button with a Root; and becauſe, according to my Experiments relating to Corn (§. 2. *c.* 3.) the Roots grow forth, and then the Eye ſhoots out when that Part of the Plant wherein it lies hid is under the Earth, or touches, at leaſt, a ſpungy Earth: This fully inſtructed me in the Nature of pruning in Gardening; by which ſome Trees and Plants, as for Example, *Lemon-Trees*, *Vine-Stocks*, *Gilliflowers* are propagated, *viz.* The Roots of the Eyes ſpring out in the Earth, and by this give more Nouriſhment to the Eye, ſo that what is little in the Button, may grow big.

§. 8. It will be made evident by and by, why a whole Tree, or other Plant of the ſame Kind, with that which the Eye belongs to, is obtained by the aforeſaid Way, after I ſhall have made it appear, how out of a ſingle Grain of Seed a whole Tree or other Plant of a certain Kind may grow.

§. 9. But before I do this, I muſt anſwer a plauſible Objection that might be made againſt what is ſaid about pruning (§. 7.) For it ſeems to follow from thence, that all Plants can be pruned whenever the Part of the Stalk, where a Leaf Sits, can be brought under or at leaſt to the Earth; becauſe, in my Opinion, in that very Place, in all Plants, there is a Shooting; that is, an Eye with a little Root, which is nothing elſe but a little Plant thoroughly formed. But Experience teaches that it is not generally to be done.

§. 10. This Objection is actually ſolved already above. For, reflecting (§. 3. *c.* 3.) upon the Experiments I was to make, to make good the true Reaſon (§. 13. *ſq. c.* 2.) of many Ears growing out of a ſingle Grain, found out by way of Meditation; I then obſerved that the Stalks ought to be pruned before the Buttons grow hard: And there deſcribing alſo, how I proceeded in my Experiments, and what Succeſs I had, I not only (§. 8. *c.* 3.) told the Reader, that I laid Earth round about the Halms, their lower Buttons being yet quite green and ſoft; but alſo that the Buttons burſted where the Roots grew forth. Wherever therefore the Bark is hard, and the Root cannot come thro', the Pruning too becomes impracticable, except you would aſſiſt Nature by Art, and make your ſelf an Opening through which the Root might come forth.

§. 11. Experience confirms what I have ſaid. For examining into the Structure of Trees and

Plants that can be pruned; and of others, where Pruning won't ſucceed, we ſee, that the firſt have a Bark which eaſily burſts, but that the latter have a Bark, which, with greater difficulty is forc'd away and ſplit. For inſtance, Vines are eaſily pruned, but then the Bark of them is not only very thin, but breaks alſo in an Inſtant.

§. 12. Mr. *Agricola*, a Phyſician at *Ratisbon*, who is pleaſed to ſpend his By-hours in uſeful Enquiries into Nature, and who has offer'd ſeveral Projects to make a general Application of theſe Methods of Multiplicating of Trees that have not been uſed hitherto but in ſome ſorts of Trees, has ſhewn alſo how to prune Trees of all Sorts to the beſt Advantage in the firſt Part of his *Eſſay on the univerſal Multiplication of Trees, Plants, and Flowers*, §. 160. *Sq.*

§. 13 I leave it to others to judge, how much this Project is to be rely'd upon, into which, as the Author ſays, *p.* 143, he fell by Chance, and when he had no Notion of the Art of expelling Roots. For he not only begs of the Reader, in the Preface to the firſt Part, tha the would publiſh nothing againſt his Projects if they ſhould not prove every where to anſwer his Expectation, he thinking himſelf able and ſincere enough to reform or refuſe them in the aforeſaid Caſe; but he has actually ſaid ſomething againſt it in the ſecond Part of his Eſſays, *p.* 16, with an Openneſs becoming the Learned.

§. 14. I have taken Notice of this Method of Mr. *Agricola*'s to bring forth Roots out of Trees in general, with no other View, but that an Objection might be drawn from it againſt my Explication of Pruning, (§. 7.) which I muſt ſolve to make it free from all Manner of Doubt.

§. 15. According to my Explication, thoſe Roots which are produced by pruning, are the little Roots that give Nouriſhment to the Eyes (§. 10. *c.* 6.) On the contrary Mr. *Agricola* has obſerved that a Sap came out of the Inciſion; and that after it was ſettled the Roots grew out of it. It ſeems by this, that Experience contradicts my Notions which are only founded upon Reaſoning.

§. 16. I find indeed that Mr. *Agricola* ſays, *p.* 160, that ſuch a Sap, by which Nature forms the Roots, is to be met with in general in all Trees. But notwithſtanding I read ſeveral Times over this, and the following, I never could convince my ſelf that Roots were grown in any other Place but that of the Eyes. However, if it ſhould happen that Roots ſhould come forth elſewhere on a pruned Bough, I am aſſured that theſe are none but Roots of Eyes that lie concealed in that Part of the Tree. For I know very well from other Principles, that nothing that is *organick* can be generated by an *inorganick* Matter.

§. 17. It is the ſame Caſe with cutting off little Boughs, and putting them under ground to take Root there, as it is with Pruning. It may be done with ſuch Plants as don't wither very ſoon, and have a ſoft Bark beſides. The Bark of 'em muſt be ſoft, for elſe the little Roots cannot come through; but they muſt neither decay in a little Time, becauſe they receive very little Moiſture out of the Ground all the Time they have ſtood without taking Root. *Roſemary*, which is propagated after this Manner, may explain this.

§. 18. In treating the preſent Subject I have had an Opportunity of inſtructing my ſelf better in the Nature of Seeds. The Grain of Seed contains in it, as every Body knows, the Matter that gives the firſt Nouriſhment to the Root and the Bloſſom. The Bloſſom conſiſts of a little Root, two Leaves in the Shape of a Heart, and one Eye. I am the Firſt that has diſcovered a little Root in the Bloſſom as far as I know, becauſe I don't remember any Book printed before my Diſſertation *upon the hard Froſt*, wherein it is taken Notice of. Moſt People have believed hitherto, that that Part of the Button or Bloſſom which appears betwixt the Leaf in the Shape of a Heart contains the whole Tree in it ſelf. But my Invention gave me an Opportunity to obſerve, that it is nothing but one Eye, in which as much is formed in little, as will grow out of one Eye. The Heart-leaves ſerve, in my Opinion, to bring the Eye to that Degree of Maturity which it has Occaſion for to ſhoot out.

§. 19. The Reaſon that induc'd me to call that Part of the Eye which lies concealed within the Tree, a Root, are theſe: Firſt, this interior and lower Part of the Eye has the ſame Figure with the lower Part of the Button in the Seed, out of which the Root is formed, even when they are examined by a Microſcope, that repreſents very diſtinctly every Thing. Secondly, it is known, that if in inoculating a yong Sprig, you hurt or break the intrinſick Part of the Eye, its Growth is ſtopt, and the little Seed does not grow forth, if the lower Part of the Button is broke off or any ways damaged. Hence I gather'd, that this lower Part of the Eye is the Part by which it muſt receive Nouriſhment if it is to ſpring up and grow, conſequently that it is a Root. I was confirmed in this Opinion upon Occaſion of the hard Froſt 1709, where I ſaw (as is mentioned §. *6. c. 6.*) that thoſe Eyes ſprung up, whoſe intrinſick Part was not damag'd by the Froſt, tho' the Wood and Bark had ſuffer'd a great deal.

§. 20. I admit of no more than one Eye in the Button betwixt the Leaf, in the Shape of a Heart, becauſe no more grows out of it; but what one Eye can contain. For, all the reſt that comes forth, grows out of new Eyes that ſettle and are generated from the Pith. I leave it to another Opportunity to enquire, how they come into the Pith, becauſe it would enlarge this Paper too much if I was to treat fundamentally of it. However, this being the Way I like to proceed in, I paſs by ſeveral Things that I could ſay of the Structure of this Eye in different Plants.

§. 21. I aſcribe to the Heart-leaves in the Bud of the Seed, the Preparation of the neceſſary Nouriſhment, by which the Eye is brought to Maturity, becauſe I have obſerved that theſe Eyes begin firſt to grow when the Heart-leaves come to Perfection; and that theſe fade away as ſoon as the other has finiſh'd its growth. For this Reaſon I doubt not but that, if the Heart-leaf was taken away, while the Seed is coming up, the Eye would be either quite ſpoiled, or at leaſt come out very ſlowly. And by this Experiment the Juſtneſs of my Opinion is inconteſtibly proved. Here I might obſerve alſo a great Likeneſs that lies hidden under the aparent Unlikeneſs in ſeveral Seeds, if this was a proper Place.

§. 22. It is Time now to ſhow, how out of one Grain of Seed a Plant, or for Inſtance, out of one Kernel a Tree grows, which is the moſt perfect Sort of Plants. The Kernel contains ſome little Particles, by which the Water that makes it ſwell up, is changed into a proper Nouriſhment. This nouriſhing Sap runs into the Bud and enlarges the

Root and Heart-leaves, and then the Seed ſhoots out. The Root under the Ground communicates the Sap to the Heart-leaves in which it is entirely prepared for the Nouriſhment of the Eye. After this is become ripe by theſe Means, it ſpreads out, and by the Sap that is conveyed from the Root into the little Stem, the Particles of it are extended and made larger. Thus much grows immediately out of the Seed, which, to ſum it up, is nothing elſe but the enlarging the Bud in the Seed.

§. 23. Therefore, becauſe in all Places where a Leaf ſits, an Eye is concealed in the Pith, which has a perfect Reſemblance to the Bud of the Seed (§. 7. *c.* 6.) and which growing forth is brought to its Maturity by the Leaves, juſt as the Eye of the Bud by the Heart-leaves; there may conſequently grow afterwards out of every Eye as much as is grown from the Seed, *viz.* a young Twig, which muſt bring forth new Eyes again, like the firſt, and ſo farther.

§. 24 There is no doubt but that the Eyes which the young Twig brings forth, are generated in the ſame Manner as thoſe of the Seed. But it ſhall be my Buſineſs another Time to know how they come into the Pith.

§. 25. As there is no more than one Eye in the Seed, out of which the whole Tree is formed, we ſee the Reaſon why by inoculating a Tree can be cauſed to grow out of a ſingle Eye, and that it is no wonder that the largeſt Trees in Woods are generated out of the ſmalleſt Grains of Seed.

§. 26. And whereas one Eye is ſufficient to a whole Tree, it is much leſs a Wonder to rear up a whole Tree by grafting a Twig that has many Eyes.

§ 27. Laſtly, as the Roots have a Pith like the Twigs, and as there are Eyes in the Pith, it is no more a Wonder, that in Caſe the Root has Sap enough, Eyes come forth from it, and grow out in By-ſhoots. Thus we ſee the Reaſon why ſome Trees and Plants can be propagated by parting the Root.

§. 28. Any Body may ſee now, that the having found out the true Cauſe of Multiplication in Corn, gives a general Light into the Production of Plants and Trees. I am in Hopes of explaining this further upon another Occaſion.

§. 29. For the preſent I obſerve only this more: By the Help of the aforeſaid Invention one ſees the Uſe of every Part of the Tree, and in general of any Plant, which has not been reflected upon before as far as I know, *viz.* the Pith brings forth the Eyes, and for that Reaſon it becomes hard Wood in Trees that bloſſom no more. But by Microſcopes we know that there is much on the Inſide of an old Bark that reſembles a Pith; and therefore it is poſſible that a Tree which has loſt its fluid Pith can nevertheleſs begin to bloſſom again out of the Bark. The Bark in particular prepares the Nouriſhment and brings it to the Eyes and Leaves; and the Leaves muſt bring the Eyes to their Maturity.

FINIS.